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Mr. Roger F. Stanley
Hanford Project Manager
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Dear Mr. Stanley:

PROPOSED GROUNDWATER AND VADOSE INVESTIGATION AT THE 216-U-14 DITCH SUPPORTING A GROUNDWATER IMPACT ASSESSMENT FOR LIQUID WASTE DISPOSAL

The enclosed Groundwater Impact Assessment describes the 216-U-14 Ditch Site geology and hydrology. An overview is provided of planned groundwater and vadose monitoring activities including well construction design, minimum physical and chemical sampling requirements for sediments and groundwater, and justifications for well locations.

If there are any questions regarding this matter, please contact M. J. Furman of my staff on (509) 376-7062.

Sincerely,

Dennis W. Claussen for.

June M. Hennig, Director
Waste Management Division

WMD:MJF

Enclosure:

cc w/o encl:
K. R. Fecht, WHC
D. E. Kelley, WHC
T. B. Veneziano, WHC
B. Austin, WHC

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Attachment 1

GROUNDWATER AND VADOSE INVESTIGATION AT THE 216-U-14 DITCH

216-U-14 DITCH GEOLOGY

A discussion of the geology of the 216-U-14 ditch is provided to define stratigraphic relationships in the immediate vicinity of the area of investigation. Delaney et al. (1991) and DOE/RL 91-52 (DOE-RL 1992c) contain a detailed discussion of the Hanford Site and 200 West Area geology.

The geology in the vicinity of the 216-U-14 ditch and 200 West Area consists of fluvial and glaciofluvial sediments. Bedrock in the area is basalt of the Columbia River Basalt Group. The uppermost basalt is the Elephant Mountain Member of the Saddle Mountains Basalt. Top of basalt is approximately 525 ft below ground surface.

The Ringold Formation overlies the basalt and consists of an intercalated mix of silt, sand, and gravel. The Ringold Formation can be divided into five facies associations based on lithofacies, petrology, stratification, and pedogenic alteration. The facies associations are fluvial gravel, fluvial sand, overbank, lacustrine, and alluvial fan deposits. The thickness of the Ringold Formation is about 110 m (362 ft).

The upper contact of the Plio-Pleistocene unit occurs above the Ringold Formation at a depth of 43.5 m (143 ft) below ground surface and consists of locally derived basaltic detritus and a carbonate-rich paleosol. The Plio-Pleistocene unit is less permeable than the overlying strata, and topography of its upper surface forms a ridge that extends south-southwest. (SEE FIGURE 1. STRUCTURE CONTOUR MAP OF PLIO-PLEISTOCENE UNIT) The early "Palouse" soil overlies the Plio-Pleistocene and occurs at a depth 41 m (135 ft) below ground surface. The early "Palouse" soil consists of eolian silt and fine-grained sand.

Glaciofluvial silt, sand, and gravel of the Hanford formation overlie the early "Palouse" soil. The Hanford formation consists of an upper gravelly coarse-grained facies and a lower, finer grained facies. The gravel-dominated facies is dominated by coarse-grained and granule-to-boulder gravel. Gravel clasts in the facies generally are dominated by basalt (50% to 80%). The sand-dominated facies consists of fine-grained to granular sand. These sands may contain small pebbles and gravel interbeds that generally fine upward into silty interbeds less than 3.3 ft thick. The sand content of these sands is typically very basaltic, commonly being referred to as black or gray salt-and-pepper sands. The contact of the two Hanford facies occurs about 25 ft below ground surface.

Sediments in the Ditch

Sediments on the bottom of the ditch have developed into two distinct horizons. The first horizon is a brown silt. This layer was likely derived from wind-blown silts and clay. The second horizon is black, fine grained, and organic rich with ash. This layer consists of a mixture of decaying vegetation and fine-grained mafic sediments. The vertical extent of these layers generally extends less than 4 ft below the ditch bottom. The lateral extent of these horizons will likely not extend beyond the ditch boundary.

216-U-14 DITCH SITE HYDROGEOLOGY

The hydrostratigraphy in the vicinity of the 216-U-14 ditch is defined by six hydrostratigraphic units. Major hydrostratigraphic units consist of ditch sediments, the Hanford formation, the early "Palouse" soil, the Plio-Pleistocene unit, the Ringold Formation, and Saddle Mountains Basalt.

Sediments within the ditch, the Hanford formation, the Plio-Pleistocene unit, the early "Palouse" soil, and uppermost Ringold Formation occur within the vadose zone. The vadose zone is approximately 205 ft thick in groundwater monitoring well 299-W19-21 adjacent to the ditch. Ditch sediments occur from the bottom of the ditch to a depth of 4 ft and consist of silt and an organic rich layer. These horizons will likely impede downward flow of water and have been shown to absorb contaminants. The Hanford formation occurs adjacent to the ditch as well as below ditch sediments. The Hanford formation consists of a highly transmissive upper coarse-grained facies and a lower, finer grained facies that may impede downward flow of water and absorb contaminants. Perched water historically has not been observed in this zone, although moisture content varies. The Palouse soil and Plio-Pleistocene unit occur stratigraphically below the Hanford formation. Because these horizons may be less permeable and restrict downward flow, perched water conditions have been established in this zone. The Ringold Formation comprises the lower part of the vadose zone and also contains the semiconfined and unconfined aquifer. Site-specific data are not available to evaluate sediment properties from the vadose zone.

The water table beneath the 216-U-14 ditch occurs within the sands and gravels of the Ringold Formation. Depth to water is approximately 60.9 m (200 ft) below ground surface, and the saturated thickness of the uppermost aquifer is about 76.2 m (250 ft). Groundwater flow is radial and generally to the northeast, away from the groundwater mound in the area of investigation (SEE FIGURE 2). No site-specific data are currently available to determine aquifer properties. The Saddle Mountains Basalt is the confining unit.

Hydrographs from groundwater monitoring wells dating back to the early 1950's and 1960 as well as more recent wells illustrate common trends in water level changes in the vicinity of the 200 West Area and 216-U-14 ditch. Figure 3 is a hydrograph of selected wells in the 200 West Area that shows the relationship between effluent discharge and rise and fall of the water table. The data available indicate that the rise in the water table increased dramatically during the first several years of artificial recharge and reached its highest levels during the 1980's. Depth-to-water measurements suggest that water levels before the onset of waste management activities, were as much as 15 m (50 ft) (122 m [400 ft msl]) lower than present levels. A comparison of the hindcast water table map of the Hanford Site for 1944 and the 200 Areas water table for June 1989 indicates that the natural water table elevation in the 200 West Area was approximately 19 m (64 ft) lower in 1944 and the hydraulic gradient was on the order of 0.001 (Delaney et al. 1991).

In 1980, water levels were 25 m (82 ft) above pre-Hanford conditions. Pre-Hanford groundwater flow direction was to the northeast based on modeling by Hall (1981). Groundwater flow direction in the vicinity of the 216-U-14 ditch will likely continue to the northeast when effluent discharge cease in the 200 West Area. Depth-to-water measurements collected since 1986 suggest that the water table is gradually declining. The decline in the water table is consistent with the decline of effluent being discharged in the

200 West Area. Since 1980 the water table has been declining at a rate of 0.3 m/year (1 ft/year).

Groundwater Investigation

Three groundwater monitoring wells will be added to the 216-U-14 ditch groundwater monitoring network. The wells will provide data to better define stratigraphy, groundwater flow direction and flow rates, and to determine the nature and extent of contamination in the vicinity of the ditch.

The new wells will be installed within the unconfined aquifer, approximately 30 ft in the water table. The extended screen section is necessary because of the current rate of decline of the water table as precipitated by the overall reduction in effluent discharge in the 200 West Area. At the current rate of decline (0.3 m/year [1 ft/year]) the well may provide access to the water table for about 20 years. Assuming that effluent discharges will cease after 1995 at the 216-U-14 Ditch and 216-U-20 Ditch, a more conservative estimate of well life may be 10-15 years. The design of newly constructed groundwater monitoring wells shall be shallow as currently outlined in the Generic Well Specification (Swanson 1990). The specification outlines basic requirements for well construction that are consistent with Chapter 173-160, *Washington Administrative Code*, "Minimum Standards for Construction and Maintenance of Well." An as-built planned groundwater monitoring design is provided in Figure 4. Groundwater monitoring wells shall be developed after completion. The location of existing and planned groundwater monitoring wells is shown in Figure 5.

Groundwater, including perched water encountered during drilling, shall be sampled and analyzed once over the next year and within the same time period after completion or well remediation as applicable. Sediment samples will be collected and classified in the field. Selected sediment samples will be submitted to the laboratory for analyses to determine various chemical and physical parameters. Groundwater monitoring wells in the vicinity of the ditch will be evaluated with the spectral gamma log and may be used to conduct aquifer tests.

Vadose Zone Investigation

Three test pits will be excavated to determine the vertical and lateral extent of contamination within the vadose zone in the eastern half of the ditch. The test pits shall be sampled to a depth of 10 ft below the bottom of the ditch, where possible. The test pits shall be backfilled after total depth is reached.

Three perched water monitoring wells will be drilled on the western half of the ditch. The monitoring wells shall be drilled to the top of the Plio-Pleistocene unit (caliche layer or layer impeding downward flow) to determine the vertical and lateral extent of contamination in the soil column and the existence and type of contamination in the perched water table. The planned vadose monitoring wells will be screened across the saturated thickness of the perched zone. The design of perched water monitoring wells shall be consistent with Swanson (1990). An as-built planned perched water monitoring well design is provided in Figure 6.

Three perched water monitoring wells exist adjacent to the eastern end of the ditch. Additional monitoring wells will not be constructed on the eastern end of the ditch because the existence of the perched zone and significant levels of uranium have been confirmed atop the Plio-Pleistocene unit. The locations of planned and existing perched water monitoring wells and test pits are shown in Figure 7.

Sediment samples will be collected during the drilling and excavation of test pits. Samples will be classified in the field. Selected sediment samples will be submitted to the laboratory for analyses to determine various chemical and physical parameters. All perched zone monitoring wells shall also be logged using the spectral gamma log.

Justification for New Groundwater Monitoring Well Locations

Eastern Half of Ditch. No new groundwater monitoring wells will be constructed on the eastern end of the ditch. Historical monitoring data suggest that existing groundwater monitoring wells are adequate for the purpose of delineating flow direction and downgradient water quality to the east. Well 299-W19-1 may be used to determine upgradient water quality. Groundwater monitoring wells constructed on the western half of the ditch will provide input to evaluate downgradient water quality.

Western Half of Ditch. No groundwater monitoring wells are available to evaluate water quality or flow direction in the immediate vicinity of the 242-S discharge pipe located on the western half of the ditch. At least three groundwater wells are needed to better define flow direction and evaluate the type and extent of contamination. Because groundwater flow direction is to the south and southwest, two wells are positioned to detect contaminants in the downgradient direction. U-14-3 is also placed away from the ditch as downward migrating water may spread laterally to the southwest on top of the Plio-Pleistocene unit. One additional well will be placed to the north to monitor upgradient water quality. Existing groundwater monitoring wells located to the east will be used to monitor flow and water quality in that direction. All groundwater monitoring will be used to determine the presence of perched conditions, delineate stratigraphic units, and ascertain the nature and extent of contamination in the subsurface.

Justification For Test Pit/Perched Water Monitoring Wells

Samples collected from the vadose zone and bottom of the ditch indicate that significant amounts of radionuclides are present. To determine the type and extent of contamination beneath the ditch, three test pits shall be excavated. Test pits shall be positioned about 20, 150, and 300 ft down-slope of the UO_3/U Plant discharge pipe to evaluate the vertical and lateral distribution of contaminants within the ditch.

Perched water monitoring wells have not been constructed to date on the western end of the ditch to characterize potential contaminants from 242-S as well as the spatial distribution of contaminants from UO_3/U Plant. The optimal location to detect contaminants and investigate perched conditions is ascertained through evaluation of the topography of the Plio-Pleistocene unit beneath the ditch. The topography of the Plio-Pleistocene unit is important because waste water may collect and migrate along its surface. Upon contact with the Plio-Pleistocene unit, waste water should accumulate and migrate to the southwest toward U Pond.

Two perched zone monitoring wells shall be positioned adjacent to the ditch (as close as possible) on the down-slope side of the Plio-Pleistocene unit. One well is placed near the 242-S discharge pipe. The other well is placed where water tends to pool near the western end of the ditch. These wells shall be used to determine the existence of the perched zone and detect contaminants with the soil column and groundwater. A third well is positioned between U Pond and the western end of the ditch to determine the extent of the perched zone, if present. This third well may not be drilled if perched water is not confirmed along the western end of the ditch.

Well Drilling and Sampling A cable tool drill rig shall likely be used to construct groundwater monitoring wells in the study area. Other types of drill rigs may also be used provided contamination can be controlled, representative samples can be collected, and borehole disturbance can be minimized.

Drive barrel sampling is the preferred method of sampling during drilling operations. Other methods of sampling are also acceptable dependent upon borehole conditions and the type of analysis required. Split spoon samples shall be used when hydraulic conductivity, radiological, or chemical sampling is required. The split spoon sampler and associated sampling equipment shall be decontaminated according to the applicable Environmental Investigation and Site Characterization procedure. Hard-tooling should be used as a last alternative to advance the well.

Physical Testing of Geologic Samples. Geologic samples may be analyzed in the laboratory for the following tests:

- Particle size distribution
- Saturated hydraulic conductivity
- Calcium carbonate
- Bulk density/porosity
- Moisture content
- Moisture retention.

Minimum sampling requirements are provided in Table 1.

Chemical Sampling and Analysis of Sediments. During the groundwater investigation, sediment samples will be collected for chemical and radiologic analysis. Sampling will be used to define the nature and extent of contamination in the vadose zone. Minimum chemical sampling requirements are provided in Table 2. Additional samples may be collected at the geologist's discretion in zones where contamination is suspected based on unusual soil discoloration, odor, and characterization monitoring or health and safety monitoring equipment. Sediment samples shall be analyzed for constituents listed in Table 3, where possible. Quality control samples will be collected as required by the Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities.

Groundwater Water Sampling. The occurrence of perched groundwater has been confirmed in existing perched water monitoring adjacent to the ditch. If perched water conditions are encountered during drilling, the groundwater shall be collected and analyzed for constituents listed in Table 3 where possible.

Planned and existing groundwater monitoring wells will be sampled after completion or after a fitness determination, as applicable. The wells shall be sampled once a year and within the same time period (i.e., 30 days). Samples shall be tested for constituents listed in Table 3, where possible.

Quality control samples will be collected as required by the Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities.

Figure 1. Structure Contour Map of Plio-Pleistocene Unit

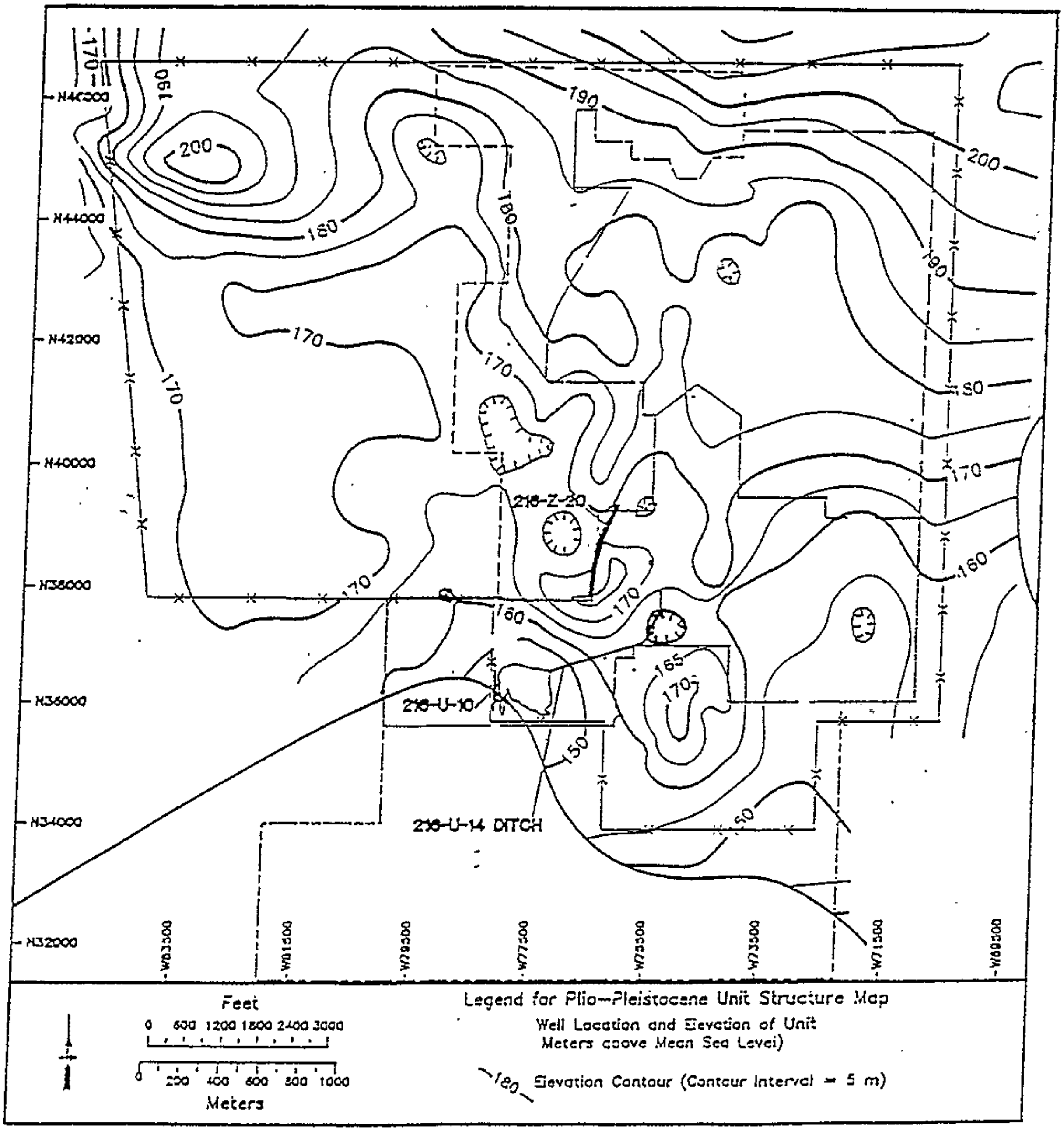

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Figure 2. 200 West Area Water Table Map.
After Kasza et al. (1992).

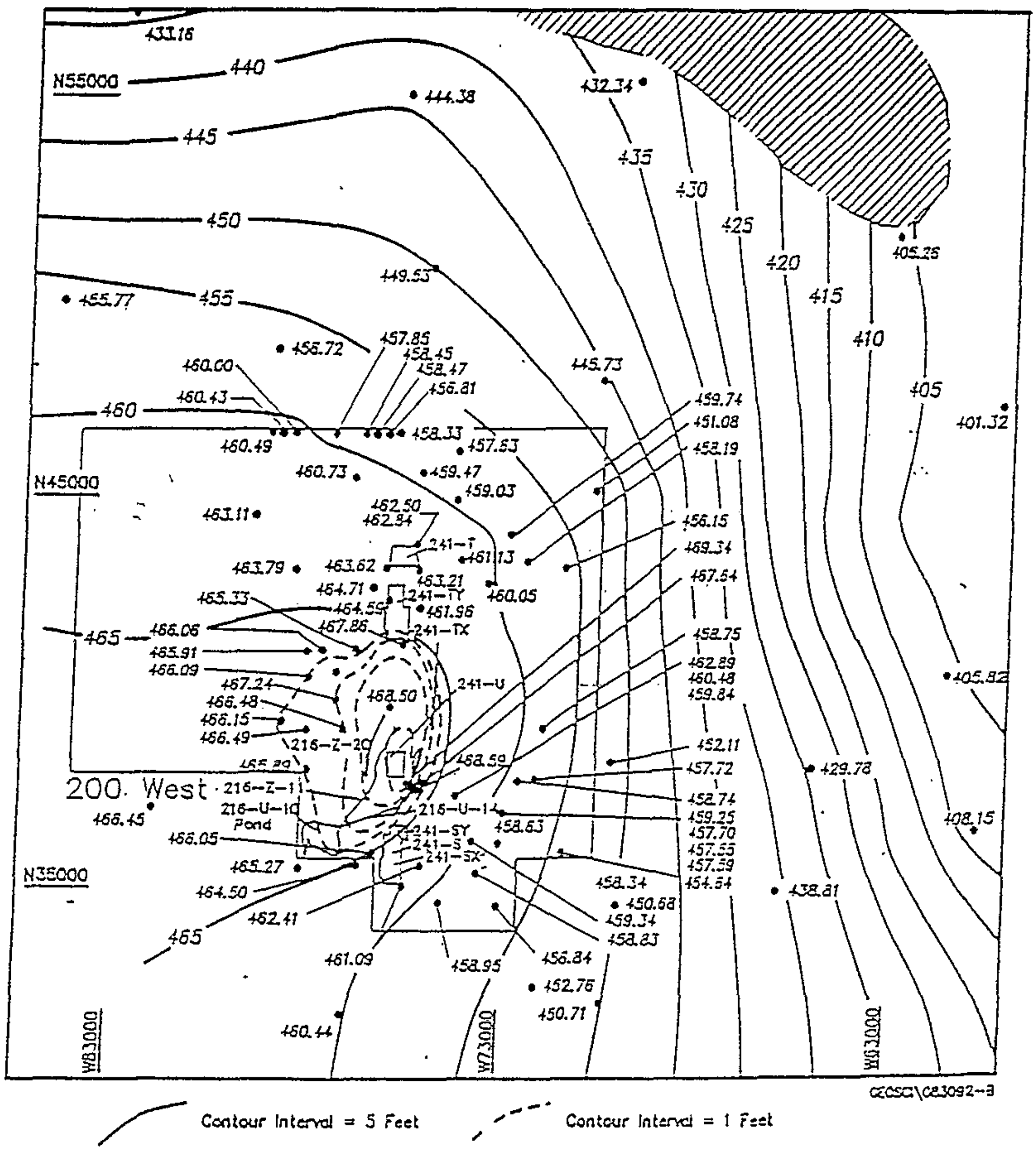
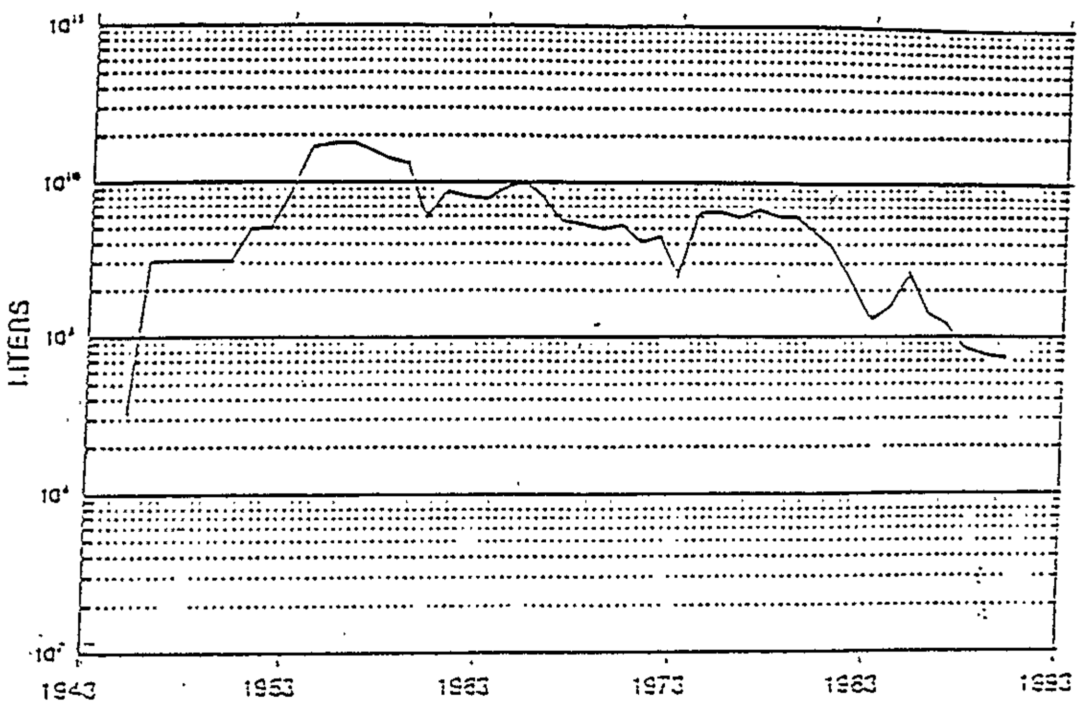


Figure 3. Hydrograph and Outflow Data from the 200 West Area Illustrating the Relationship Between Effluent Discharge and Rise and Fall of the Water Table.



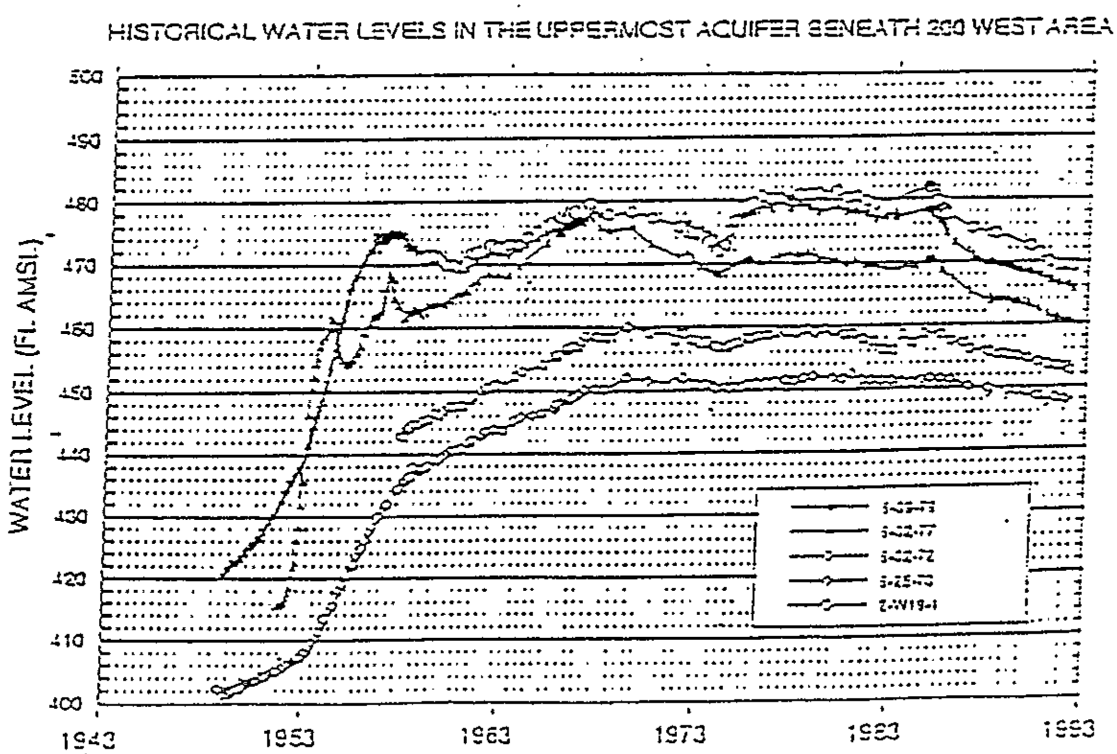


Figure 4. As-Built of Planned Groundwater Monitoring Well Design

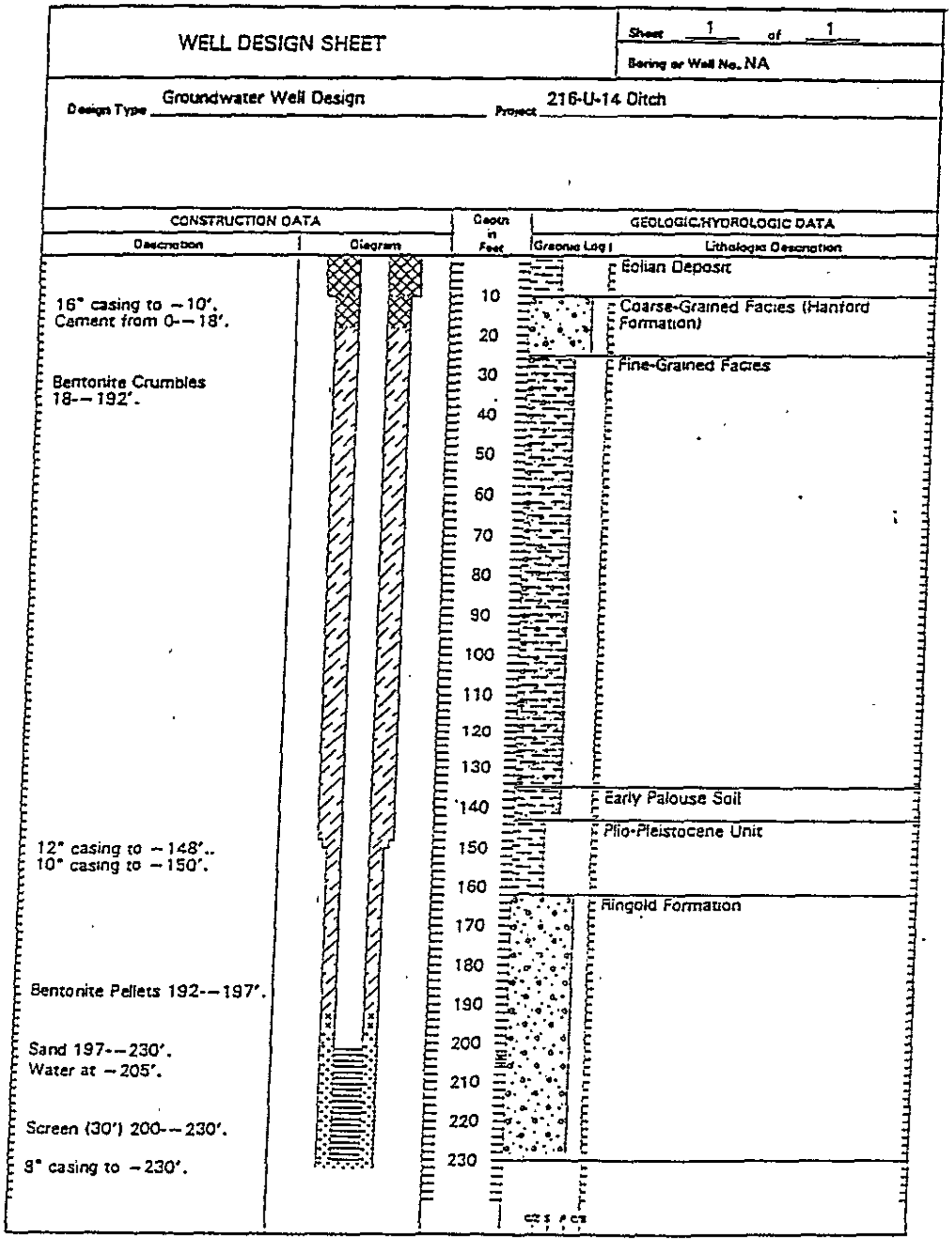


Figure 5. Location Map of Existing and Planned Groundwater Monitoring Wells.

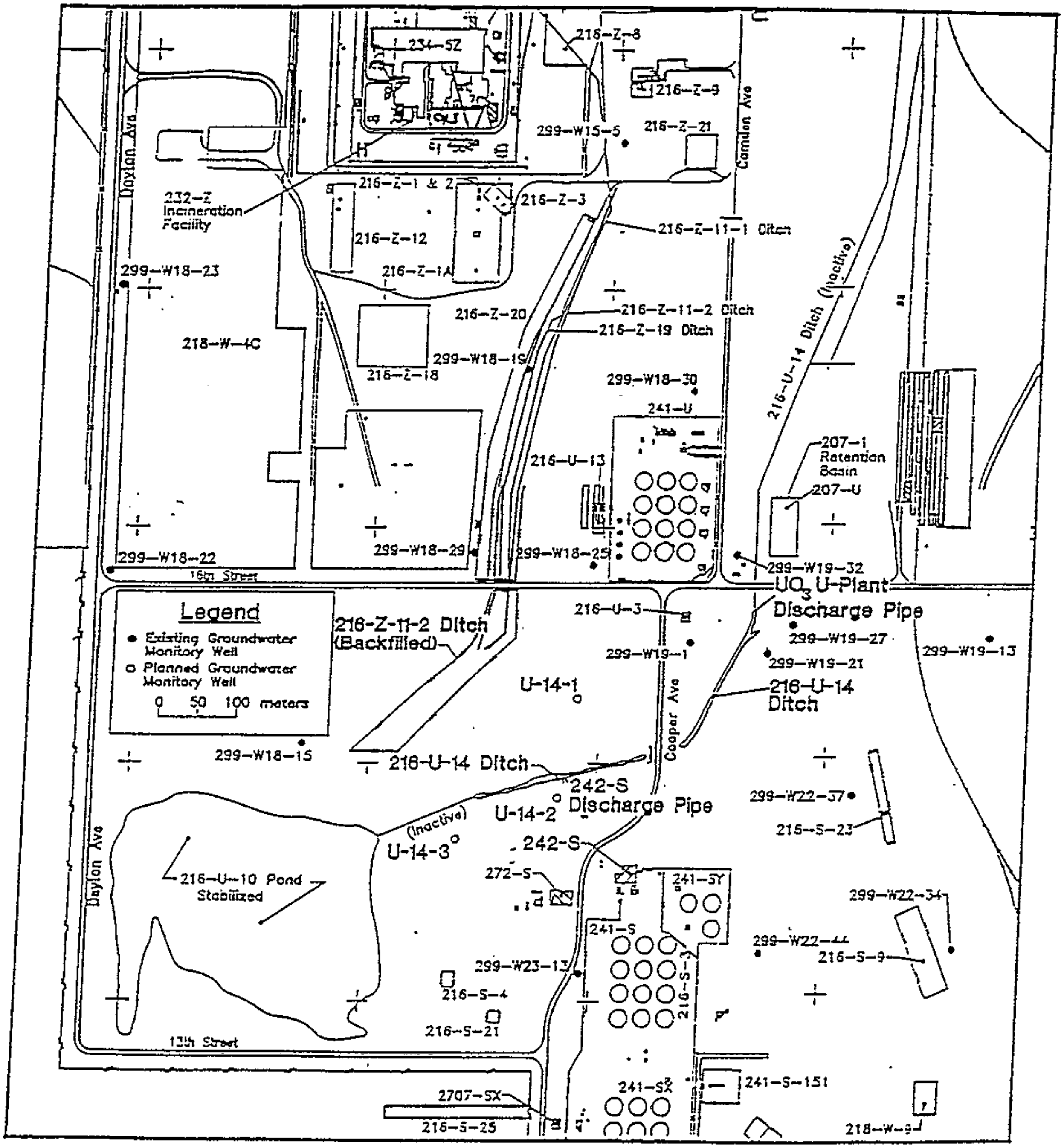


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Figure 6. As-Built of Planned Perched Water Monitoring Well Design

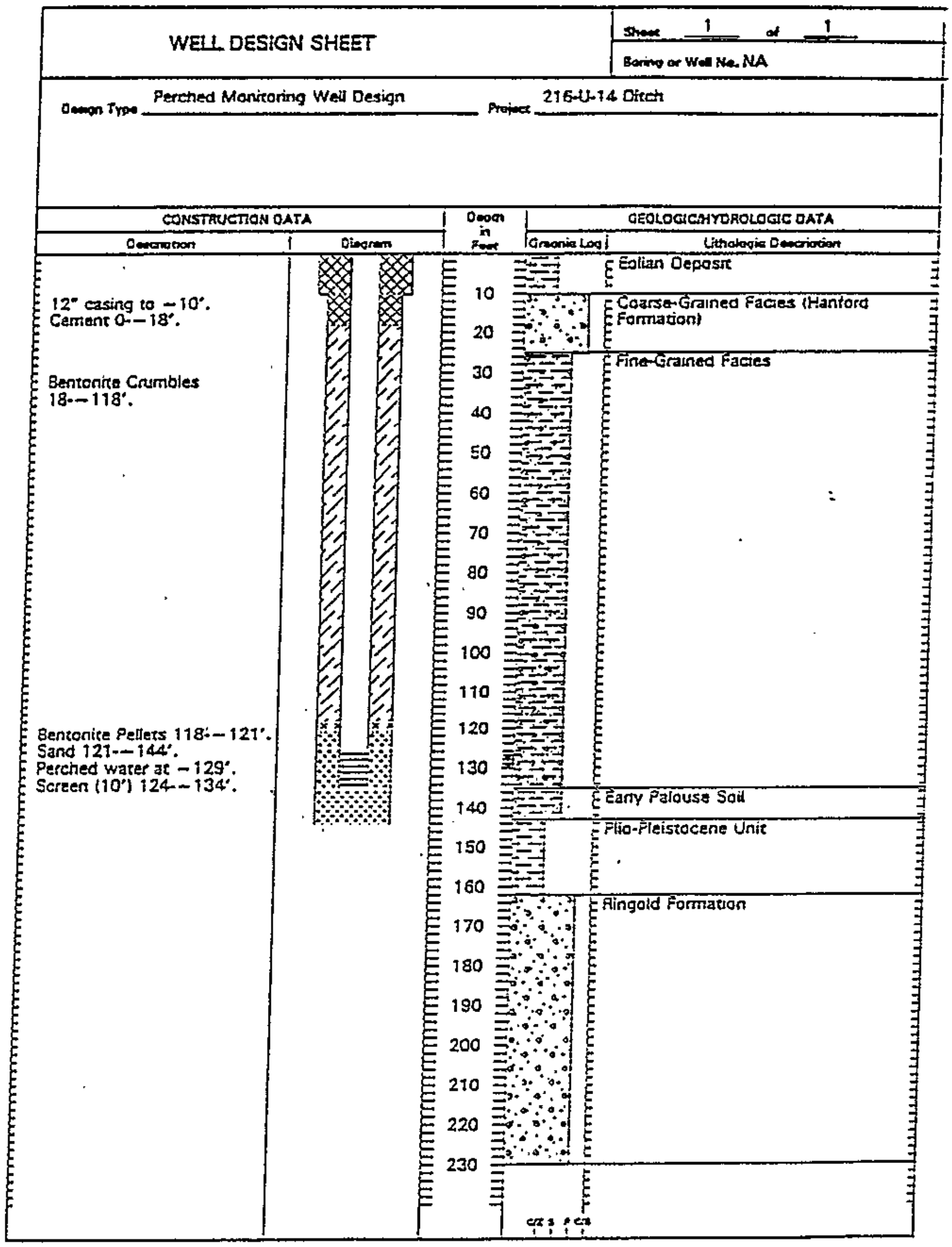

Figure 7. Locations of Planned and Existing Perched Water Monitoring Wells and Tests Pits.

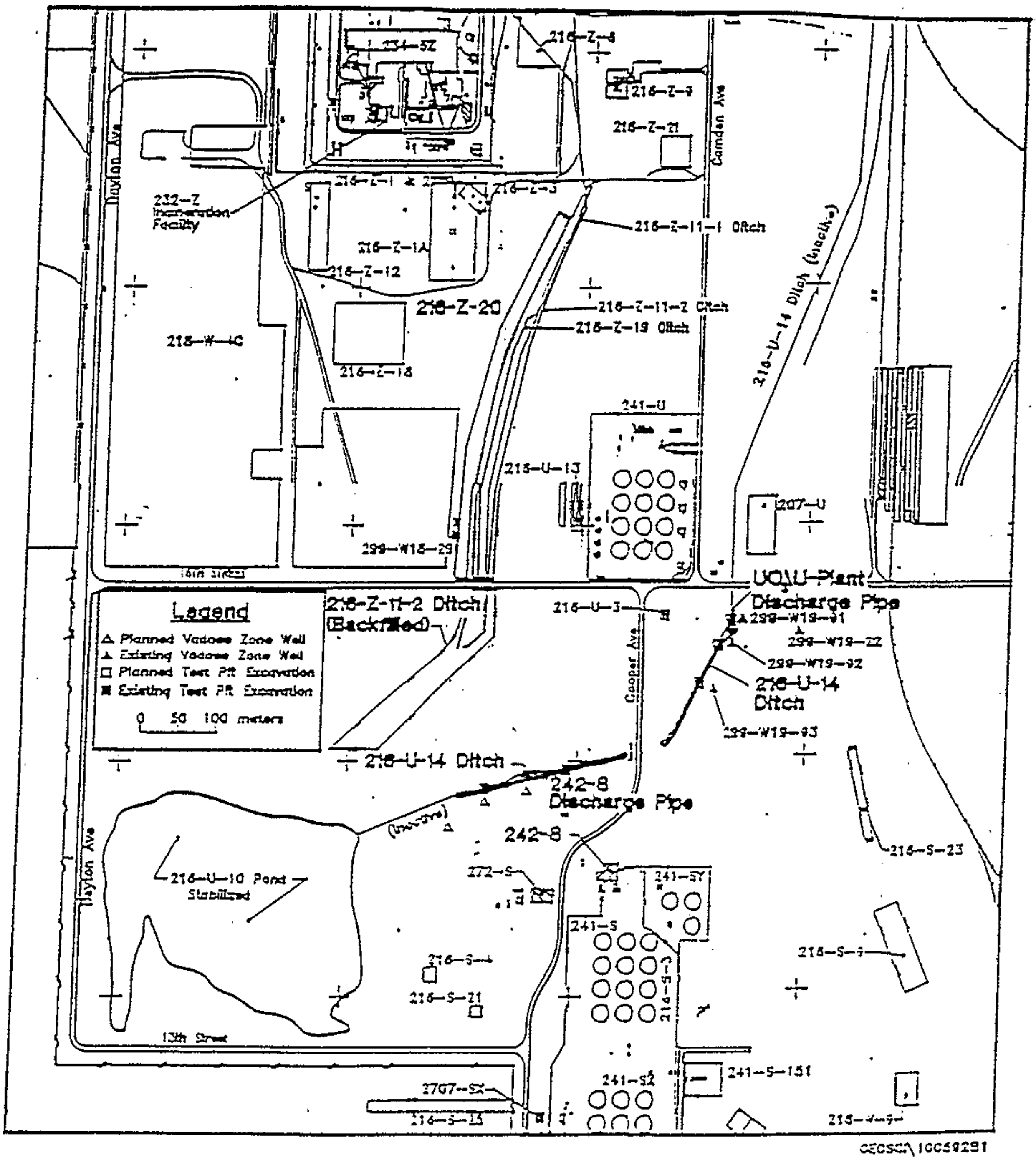

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Table 1. Physical Testing Sample Schedule For Sediments.

Depth	* U-14-1, U-14-3	** PWMW-2	U-14-2, PWMW-1, and PWMW-3
0.5			
1.0			
4.0			
5.0	1	1, 2	1
6.0			
7.0			
8.0			
10.0[a]	1, 2, 3	1, 2	1, 2, 3
11.0			
14.0			
15.0	1	1, 2	1
16.0			
18.0			
20.0	1	1	1
25.0[a]	1, 2, 3	1, 2, 3, 4, 5, 6, 7	1, 2, 3
30.0	1	1, 2	1
40.0	1	1, 2	1
50.0	1, 2, 3	1, 2	1, 2, 3
135.0[b]	1, 2	1, 2	1, 2
140.0[c]	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6, 7
200.0	1, 5, 7		

Where possible, geologic samples will be collected and submitted for analysis according to this schedule. Additional samples may be collected at the geologist's discretion. (1) moisture content, (2) calcium carbonate, (3) grain size distribution, (4) porosity, (5) bulk mass density, (6) hydraulic conductivity, and (7) moisture retention.

[a]Facies changes
[b]Palouse soil
[c]Approximate top of the caliche layer.
*U-14-# denotes groundwater monitoring well.
**PWMW-# denotes perched water monitoring well.

Table 2. Chemical Sampling Schedule for Sediments.

Depth	New groundwater monitoring wells	216-U-14 Ditch	Perched water monitoring wells
0.5		1	
1.0		1, 2	
4.0		1	
5.0	1		1
6.0		1, 2	
7.0			
8.0		1	
10.0[a]	1	1, 2	
11.0			1
14.0			1
15.0			
16.0			1
18.0			1
20.0	1		1
25.0[a]	1, 2		1, 2
30.0	1		
40.0	1		
50.0	1, 2		1, 2
135.0[b]	1		1
140.0[c]	1, 2		1, 2
200.0	1		

Where possible, geologic samples will be collected and submitted for analysis according to this schedule. Additional samples may be collected at the geologist's discretion.

1 = Cesium 137, strontium-90, plutonium-239, uranium isotopes, americium-241, technetium-99.
2 = Appendix IX and other contaminants of concern.
[a]Facies changes
[b]Palouse soil
[c]Approximate top of the caliche layer.

TABLE 3

216-U-14 DITCH ANALYTE LIST

The analyte list in this appendix is determined based upon contaminants detected in the 216-U-14 waste stream, subsurface, and the waste stream analyte list identified in the effluent specific sampling and analysis plan.

Appendix IX	Acidity
Alkalinity	Aluminum
Ammonium	1-Butanol
Conductivity	Dichloromethane
Boron	Iron
Fluoride	Manganese
Magnesium	Nitrate
pH	Phosphate
Sulfate	Silicon
Total oil and grease	Tetrahydrofuran
Total dissolved solids	TOC
Americium-241	TOX
Cesium-137	Trichloromethane
Uranium isotopes	Plutonium-239
Technetium-99	Strontium-90
	Tritium

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Subject: PROPOSED GROUNDWATER AND VADOSE INVESTIGATION AT THE 216-U-14 DITCH SUPPORTING A GROUNDWATER IMPACT ASSESSMENT FOR LIQUID WASTE DISPOSAL

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*Reissue on 4/22/93 to show RD Wojtasek as the correct Assignee.

**Reissue on 4/28/93 to show TV Veneziano as the correct Assignee.

(Reissues per Direction from Diane Hunter)

Attachments to this letter are the same as external letter 9351878.

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